¡HTML¿ ¡HEAD¿

¡TITLE¿Symmetry Principles of the Unified Field Theory: Charges as the Symmetry Debts of Light and its Dimensional Metric ¡/TITLE¿ ¡meta name=”description”content=”the role of symmetry in the unified field theory”¿ ¡meta name=”keywords”content=”unified field theory, theory of everything, symmetry, supersymmetry, Einstein, Noether, general systems, gravitation, weak force, strong force, electromagnetic force, four forces of physics, quarks, leptons, neutrinos, IVBs, baryons, photons, gluons, gravitons, mass, light, quantum radiance, Hawking, spacetime, space, time, leptoquark, Higgs, charge, entropy, conservation, quantum, color charge”¿ ¡meta name=”classification”content=”physics, unified field theory, theory of everything, general systems”¿ ¡meta name=”author”content=”John A. Gowan”¿ ¡!– Date: 1997 –¿

¡/HEAD¿

¡BODY¿ John A. Gowan 1997 (revised Nov. 1999)¡P align=center¿ http://www.people.cornell.edu/pages/jag8¡P¿

¡h1¿Symmetry Principles of the Unified Field Theory¡/h1¿

¡P align=center¿ Contents:¡BR¿

¡ul¿ ¡l1¿¡A HREF=”row one”¿Row one: Symmetric Energy States: Creation Event¡/A¿¡BR¿ ¡ul¿ ¡l1¿ Light and Spacetime¡BR¿ ¡l1¿¡A HREF=”leptoquarks”¿Particles, Leptoquarks¡/A¿¡BR¿ ¡l1¿¡A HREF=”symmetry”¿Sym Breaking¡/A¿¡BR¿ ¡ul¿ ¡l1¿IVBs¡BR¿ ¡/ul¿ ¡/ul¿

¡l1¿¡A HREF=”row two”¿Row two: Particles - Raw Energy Conservation¡/A¿¡BR¿ ¡ul¿ ¡l1¿ Mass¡BR¿ ¡l1¿¡A HREF=”time”¿Time¡/A¿¡BR¿ ¡l1¿¡A HREF=”interval”¿Time, Gravitation, Interval¡/A¿¡BR¿ ¡l1¿¡A HREF=”quarks”¿Quarks and Leptons¡/A¿¡BR¿ ¡ul¿ ¡l1¿Quarks¡BR¿ ¡l1¿Hadrons and Leptons¡BR¿ ¡l1¿Neutrinos¡BR¿ ¡/ul¿ ¡/ul¿ ¡l1¿¡A HREF=”row three”¿Row three: Charges - Symmetry Conservation¡/A¿¡BR¿ ¡ul¿ ¡l1¿Electric Charge¡BR¿ ¡l1¿¡A HREF=”global”¿Gravitational Charge¡/A¿¡BR¿ ¡l1¿¡A HREF=”color”¿Color Charge¡/A¿¡BR¿ ¡l1¿¡A HREF=”number”¿Number Charge¡/A¿¡BR¿ ¡/ul¿ ¡l1¿¡A HREF=”row four”¿Row four: Fields - Symmetry Payments¡/A¿¡BR¿ ¡ul¿ ¡l1¿ Photons¡BR¿ ¡l1¿¡A HREF=”gravitons”¿Gravitons¡/A¿¡BR¿ ¡ul¿ ¡l1¿¡A HREF=”shunt”¿Time Shunt¡/A¿¡BR¿ ¡l1¿¡A HREF=”quantum”¿Quantum Radiance¡/A¿¡BR¿ ¡/ul¿ ¡l1¿¡A HREF=”gluons”¿Gluons¡/A¿¡BR¿ ¡l1¿¡A HREF=”ivbs”¿IVB’s¡/A¿¡BR¿ ¡/ul¿ ¡l1¿¡A HREF=”summary”¿Summary¡/A¿¡ ¡l1¿¡A HREF=”appendix”¿Appendix¡/A¿¡BR¿ ¡ul¿

¡l1¿¡A HREF=”simple”¿Table of Energy States and Forces¡/A¿¡BR¿ ¡l1¿¡A HREF=”partable”¿Table of Particles¡/A¿¡BR¿ ¡l1¿¡A HREF=”list”¿List of Technical Terms¡/A¿¡BR¿

¡/ul¿ ¡/ul¿ ¡P¿ (The format of this paper (”row 1”, ”row 2”, etc.) follows a ¡A HREF=”simple”¿4x4 table¡/A¿ which the reader should access).

¡h2¿Row 1 - ¡A name=”row one”¿Symmetric Energy States¡/A¿ and the Creation Event¡/h2¿ ¡h3¿Light and Spacetime ¡/h3¿¡P¿

In this row (¡A HREF=”simple”¿see table¡/A¿) I list the symmetric forms of free energy, and the breaking of their symmetry, during the Creation Event - the Big Bang. The Universe begins as light - free electromagnetic energy - which is a perfectly symmetrical energy form. Light carries no charges of any kind, produces no gravitational field, and has no time dimension in the ordinary sense. Light’s intrinsic motion C is a symmetry condition formally characterized by Einstein as its zero Interval, which is a condition of non-locality. ¡P¿

Spacetime is the conservation domain of light, created by the intrinsic motion of light for its own conservation. The creation of spacetime by light is implicit in the formulation of its intrinsic motion - frequency (time) x wavelength (space) = C, the electromagnetic constant or velocity of light. Before the creation of matter the concept of time can only be applied globally to the Universe as a whole, in the sense of entropic expansion and cooling, not locally to its parts, as we do today. Einstein teaches us that before the creation of matter, there is only one clock, the Universe; after the creation of matter, every particle carries its own timepiece, whose rate depends upon its relative motion and gravitational environment.¡P¿

The zero Interval of light means that light is everywhere throughout its conservation domain simultaneously - a symmetry condition with respect to the distribution of light’s energy within its conservation domain (”symmetry” refers to a condition of balance, sameness, or equality). The electromagnetic constant C is the gauge or standard for the metric of spacetime, the fixed relationship which establishes the equivalence of measurement between the dimensions: 186,000 miles of space is metrically equivalent to 1 second of time. At C this equivalence is complete and time is suppressed to a locally implicit state. ¡P¿

In a universe of pure light, before the creation of matter, the metric is everywhere the same, as no gravitational fields are present to disturb its symmetry. The metric is a necessary condition of the spacetime domain, indeed the very reason for its existence, as it is the regulatory mechanism which performs the conservation function of the domain, controlling and coordinating the rate of expansion and cooling of spacetime both globally and locally. The entropy of light is expressed through its intrinsic motion. But it is light's intrinsic motion which creates its conservation domain. Therefore light and spacetime are related as the first and second laws of thermodynamics.¡P¿

Our physical universe, including the conservation domain of spacetime, is wholly the product of a single form of energy - electromagnetic energy (the ”monotheism” of physics). Light is the most primordial form of this energy, which we know because light has the greatest symmetry of any energy form; light is the form from which all other energy forms are made, and to which they all reduce. Light and spacetime can no more be separated than energy can be separated from its conservation laws.¡P¿

¡A name=”leptoquarks”¿¡h3¿Particles¡/h3¿¡/A¿ Matter consists of two types of massive particles, the elementary particles with no internal parts, called leptons, and composite particles with internal parts (quarks) called hadrons. Together they comprise atomic matter, the electron a member of the lepton family, and the nuclear particles (protons and neutrons) examples of the hadron family. Hadrons containing a quark-antiquark pair are known as mesons, while those containing 3 quarks are called baryons; no other quark combinations exist (¡A HREF=”partable”¿see Particle Table¡/A¿).¡P¿

Together, light and metric spacetime have the capacity to produce particles, which are essentially a ”packaging” of light's free energy. The mechanism by which this transformation of wave to particle occurs is still unknown, although actively investigated. We believe our universe began as an incredibly hot, energy dense, and spatially tiny ”singularity” - the standard ”Big Bang” model. One can readily appreciate that a simple ”packaging” mechanism for compactly storing the wave energy of light - which by its very nature (its intrinsic motion) takes up a lot of space - would be useful in the spatially cramped conditions of the initial moments of the Big Bang. In a purely pragmatic way this packaging concept accounts for the existence of particles and some of their salient features: the spectrum of identical elementary particles of various masses (the leptonic series), the heavier ones presumably more useful ”packages” at higher energy densities, and similarly, the spectrum of composite particles (baryons), which can store additional energy internally, as if they contained a set of compressible springs (the quarks). Finally, massive particles can store an unlimited quantity of energy as momentum, a feature of particular utility in the early universe, helping to avoid the ”still birth” of a cosmic ”black hole”.¡P¿

I presume there is a mechanical relationship between the metric of spacetime and the structure of particles. Light exists as a 2-dimensional energetic vibration of the metrical structure of spacetime. Usually this vibration is simply transmitted through the metrical structure at velocity C, the ”inertial” symmetry condition imposed upon light by its conserving metric. However, it is also possible for this vibrational energy to somehow become entangled in the metric and tie itself into higher dimensional ”knots”, which cannot be transmitted at C because they are no longer 2-dimensional. Such ”knots” comprise particle-antiparticle pairs, and their structure and information content is derived from the mixture of metric spacetime and light. The otherwise inexplicable existence of three energy families of both quarks and leptons is almost certainly a consequence of the origin of particles as electromagnetic ”knots” in the 3 spatial dimensions of the metric. The connection between energy, the metric, and the structure of particles is currently being investigated by ”string” theory. ¡P¿ Four-dimensional ”knots” will contain an asymmetric dimension, time, which is presumably the source of the weak force asymmetry in its matter-antimatter interactions. Just how leptonic knots differ from quark knots (dimensionally? topologically? symmetrically?) remains a mystery. Nevertheless, deriving both from the same spacetime metric provides an essential conceptual basis for understanding their relationship. The further value of such theoretical notions is that they provide a direct connection between light, spacetime, and matter, a connection which is evident in other phenomena, such as the interchangeability of light and matter in the creation and annihilation of particle-antiparticle pairs, Einstein's and Debroglie's mass-energy relations, the gravitational and electromagnetic fields of particles, etc.¡P¿

It remains a mystery how the elementary leptons are related to the composite baryons, but it is plausible that this relationship is through an ancestral particle (the ”leptoquark”) which ”fractured” under the high pressure of the Big Bang and so could store more energy. This notion is based on the theory of ”asymptotic freedom” (Politzer, Gross, Wilczek) - a symmetry principle - which observes that as the quarks of a baryon are squeezed together, the strong force which binds them becomes weaker, affording the quarks more freedom of movement. If the quarks are squeezed together completely, the color charge of the gluon field sums to zero (see row 4, "Gluons"), leaving a particle indistinguishable from a heavy lepton, the leptoquark. A "colorless" leptoquark would therefore be susceptible to a typical weak force decay via the "W", a particle we examine in the following section.¡P¿

¡h3¿¡A name="symmetry"¿Symmetry Breaking and the Weak Force¡/A¿¡/h3¿ ¡P align=center¿ ¡B¿Leptons as Alternative Charge Carriers¡/B¿¡P¿

The leptonic field of elementary particles functions as alternative charge carriers for the quark field of the hadrons. Without these alternative charge carriers, (electrons carry electric charge, neutrinos carry number or "identity" charge), the quark field would remain locked in symmetric particle-antiparticle pairs. Hence we see that in order to produce an asymmetric, isolated particle of matter from a symmetric particle-antiparticle hadron pair, we require two fields: 1) a primary symmetric field (the quarks, hadrons, and leptoquarks); 2) a secondary field (the leptons - electrons, neutrinos, and their kin). The secondary field must furthermore be asymmetric at two levels of interaction: A) it must itself be able to exist as isolated particles (rather than as particle-antiparticle pairs), so that it can function as an alternative charge carrier for the symmetric field (and for its own members); B) its reaction with particles must proceed at a different rate than its reaction with antiparticles. A final requirement is that there must exist some fundamental basis of similarity between these two fields if they are to interact at all - they must be able to recognize each other at the quantum level of charge. For example, the electrical charge of the proton is exactly equal in magnitude to that of the positron or electron, and the number or identity charge of the neutrinos must likewise be exactly equal in their characteristics to that of the identity charges of the leptoquark and other leptons.¡P¿

Obviously, the relationship between the quark and lepton fields must be intimate, and almost certainly they are related through ancestry, that is, one is derived from the other, both are derived from the metric, both are decay products of the leptoquark, etc. A complex arrangement, but nothing less will suffice to break the initial symmetry of energy.¡P¿

¡h3¿¡A name="ivbs"¿IVB'S - Quantum Process and Particle Transformation¡/A¿¡/h3¿ The field vectors or force carriers of the weak force are known as Intermediate Vector Bosons, or IVB's. The IVBs include the W+, W-, and Z (neutral) particles. As a group, they are the most unusual particles known and the most difficult to understand.¡P¿

The weak force is the asymmetric physical mechanism that produces elementary massive particles from light, and governs the transformation of one elementary particle into another. Only 3 massive elementary particles are known, the electron, muon, and tau, identical in all their properties other than mass and identity charge. This is the leptonic particle family, series, or spectrum. It is a quantized mass series, each member separated from the others by a large, discreet, and exact mass difference. I suspect the leptoquark is the 4th and heaviest member of this series, representing the "evolutionary" common ancestor (in terms of time and energy as well as relationship) of the baryons and leptons. It is the role of the IVB's 1) to produce the leptonic series from the symmetric "sea" of particle-antiparticle pairs, and 2) govern the transformations and decays of one elementary particle into another. The Z governs certain neutral weak force interactions in which particles simply swap identities.¡P¿

What is most remarkable about the IVBs is that they seem to be processes in quantized, massive, particle form. These are not particles like the leptons and baryons which form stable matter; they are particles of interaction, present only when mediating a reaction, "virtual" particles usually known only by their effects, existing within the Heisenberg Interval of virtual reality, but real enough and producible if the ambient energy density is sufficient. ¡P¿ The IVB's are the most complex example of nature's penchant for quantization that we know of, and like many quantum processes, are responsible for a good deal of head-scratching. I can think of two reasons why this process should be quantized: 1) quantized units are indefinitely repeatable without loss of information or precision (Nature's digital information coding), and 2) how otherwise could the asymmetry of the weak force be built into its structure?¡P¿

The W particle (which is nowadays readily produced in accelerators) is approximately 90 times heavier than the proton, which explains the relative weakness of the weak force - there is a huge energy barrier to surmount before weak interactions can occur. However, this also raises the obvious question of what this massive particle is composed of - certainly not ordinary matter, the stuff of baryons and leptons. My guess is that this particle (and the IVBs generally) is nothing less than a piece of very compact spacetime metric, derived perhaps from the dense metric of the early moments of the Big Bang. The huge mass energy of the particle is the binding energy required to compact the metric, fold it, and secure it in the particular configuration of the W or Z. Hence this particle is similar to the compacted, topological, multidimensional particles of string theory. ¡P¿

While this is pure speculation, the notion has several advantages. First, it offers a mechanical explanation for the reactions mediated by this particle. The dense metric of the W simply functions to bring the reactants of a weak force process into such close proximity that they can exchange charges in full satisfaction of the conservation laws, which they cannot do when separated by ordinary distances. Typically this will involve a particle-antiparticle pair drawn from the virtual particle "sea", as well as the reacting particle itself. For example, in the case of the decay of a muon to an electron, the W brings together within its dense metric an electron-positron virtual particle pair, and the muon. When these particles are sufficiently close together, the positron and muon cancel each other's electric charges, and release their identity charges as neutrinos. The reaction is possible only because the muon is so close to the particle pair that it can transfer its mass-energy to the electron, materializing the virtual particle, thereby conserving the overall electrical charge of the reaction. This scenario furthermore illustrates the possible mechanism underlying the role of leptonic particles as alternative charge carriers, not only for the quarks, but for themselves as well. ¡P align=center¿

We write this reaction as (with antiparticles in uppercase; v = neutrino, u = muon, e = electron):¡BR¿¡P align=center¿

u-(E+ x e-)w- —— vu + vE + e-¡BR¿

(See other reaction examples below the ¡A HREF="partable"¿Particle Table¡/A¿).¡P¿

The muon in this decay can be replaced by a tau lepton, a meson, a baryon, or a leptoquark (of course, the products will be different). This type of reaction, involving particle-antiparticle pairs drawn from the virtual "sea", explains how the W can participate in so many different reactions and produce so many different products without changing its own identity. The W acts as a sort of "metric catalyst", simply bringing particles into very close contact with each other. Another advantage of the theory is that if the W is a metric particle, then it may also contain an element of time, which could be the source of its asymmetric character. A further advantage, of course, is the contact with string theory. ¡P¿

This mechanism also raises another possibility: if the W has a "big brother", it might be powerful enough to squeeze the quarks of a baryon sufficiently to cause the color charge to vanish (asymptotic freedom), and initiate proton decay. The energy barrier to proton decay is very high (leptoquark mass), so such a particle would have to be very heavy indeed. ¡P¿

While the details of this process remain to be clarified by experiment, the general picture is clear. There is a specific mechanism for transforming light into its particle form, which we call the IVBs of the weak force. This mechanism produces the leptonic spectrum of elementary particles. This particle spectrum contains the leptoquark as its heaviest and highest energy member; the leptoquark is the first particle actually isolated by the asymmetric action of the weak force W during the Big Bang. Subsequently, the leptoquark decays to produce both the lower energy (lighter) baryons and leptons. ¡P¿

Spacetime is the conservation domain of light. As such, it is very particular about what happens to its free energy content, and strictly regulates the transformation of light to bound forms. The weak force is the guardian of the transformation process - all candidates for transformation must pass through its gates, stop at its checkpoint, receive identity tags and quantized forms - and just those that spacetime is prepared to conserve, no others. This is nothing less than a border crossing, requiring passports. Once these conservation formalities have been observed, the particles are free to pass through the boundary between the 2-dimensional, spatial conservation domain of light, and enter the 4-dimensional temporal conservation domain of mass, where they still must obey the (transformed) laws of energy, entropy, and symmetry conservation. ¡P¿

In the initial phase of particle creation, particle-antiparticle pairs, presumably of all types, are created and annihilate each other instantly, recreating the light energy from which they were made. So long as these pairs are created and annihilated in equal numbers, the symmetry of the light universe is maintained. But there is an inherent asymmetry in the way the weak force interacts with matter vs antimatter, with the consequence that even though particle pairs are created symmetrically, they do not decay symmetrically. Most probably these asymmetric decays occur in neutral leptoquarks, heavy analogs of the neutron. An excess of matter is produced in this process, breaking the symmetry of the light universe and creating the matter comprising the universe we see today. For a discussion of these reactions, see: ¡A HREF="origin.html"¿"The Formation of Matter and the Origin of Information"¡/A¿. It is the consequence of this broken symmetry that we will trace in the remaining rows of the model.¡P¿

¡h2¿Row 2 - Particles - ¡A name=”row two”¿Raw Energy¡/A¿ Conservation¡/h2¿ ¡h3¿Mass¡/h3¿ This is the row of bound energy: conservation of raw energy in terms of massive particles, momentum, etc, rather than symmetry. Einstein's most famous formula, E=MC2, expresses the notion that the energy stored in mass in enormous and somehow related to light through the electromagnetic constant C. DeBroglie noted that Plank's formula for the energy of light E=hv (where v = the frequency of light, and h = Planck's constant) contained the same E and wrote hv=MC2, expressing the conversion of free energy to its bound form. This equation states that all the energy of light is conserved in massive form in this transformation.¡P¿

We might think with some justification that energy conservation is satisfied by DeBroglie's equation and nothing more need be said. But this is just raw or total energy conservation, conservation of quantity, not quality. The quality, or symmetry, of free energy has not been addressed by this formula. No massive particle can be created from free energy without engendering a symmetry debt and charge of some sort; if the free energy is simply absorbed by an existing massive system (for example, the electron shell of an atom), without the creation of a new charged particle, then at least a gravitational symmetry debt will be recorded. The same is true for changes in the momentum of massive systems. At its most basic level, this is the transferral and conservation of the entropy of one system to another. You cannot transfer energy from one system to another without also transferring the entropy of that energy, which in massive systems is expressed as gravitation.¡P¿

The basic function of mass is apparently the compaction (”packaging”) and storage of free energy as touched upon in the discussion of row one. Mass is bound energy, and it is asymmetric in many ways by comparison to free energy. For this reason mass carries various charges, which are symmetry debts whose origin we have traced to the perfect symmetry of light (see row 3). The most fundamental symmetry debt of mass is dimensional - mass is 4-dimensional, with intrinsic motion in time rather than space. The time dimension itself is of course asymmetric, being one-way. Free energy (light), from which mass is formed, is a 2-dimensional transverse wave.¡P¿

Bound energy's most obvious asymmetry is its lack of intrinsic spatial motion C. This attribute gives bound energy a different inertial status than free energy, because bound energy has a different dimensionality than free energy. The Interval of free energy = 0, but bound energy has a real, positive Interval (because of its time dimension) and a gravitational field; both are asymmetric dimensional attributes. We associate electric charge with the dimensional asymmetry of time, and the gravitational charge with the positive Interval of bound energy.¡P¿ Finally, the entropy of light is expressed as its intrinsic motion in space. In mass, the entropy of light is converted to and conserved as the gravitational field of mass. This gives mass an intrinsic spatial motion of its own (the gravitational flow of space) which creates time (see below), the dimensional conservation domain of mass.¡P¿

¡h3¿¡A name=”time”¿Time¡/A¿¡/h3¿

By energy conservation, the intrinsic motion of mass in time must be metrically equivalent to light's intrinsic motion in space. This is just to say that mass must participate in the metrical regulation of spacetime, since the metric is the expression of energy conservation in the dimensional arena. The energy accounts of mass in relative motion would not balance otherwise - there would be no reason for the existence of time. The consequence is that matter as well as light exists at the edge of the expanding (or contracting) domain of spacetime. Hence from our position on this edge or surface we can only look backwards in time as we look outward in space, in every direction to the 4-dimensional center of the universe, its origin in the Creation Event, a center which paradoxically surrounds us completely, receding from us at the velocity of light (or time). (For a complete explanation of this view, see ¡A HREF=”spacetxt.html”¿” A Spacetime map of the Universe”¡/A¿.)¡P¿ Mass requires the time dimension to balance its energy accounts because the energy contained in mass varies with its velocity, and velocity involves time. Light does not require this accommodation because its velocity is invariant; light's energy varies not with velocity but with its frequency. Distance and time are on an equal footing with light; for massive objects they are vastly different, one second being metrically (dimensionally) equivalent to 186,000 miles of distance. For mass, the conservation of energy requires the time dimension to become explicit and distinct from space, whereas for light the time dimension remains implicit. Time acquires its one-way characteristic for mass because raw energy conservation forces the continual updating of its accounts, from one instant to the next. There is no ”buy now, pay later” plan for raw energy. It is ”cash and carry” only. This is not the case for symmetry conservation, however. ¡P¿

A fundamental difference between symmetry conservation and raw energy conservation is the indifference to time of the conserved charges which represent and carry symmetry debts. These charges do not vary with time or velocity. Once acquired, a symmetry debt (such as electric charge) can be repaid at any time (neutralized, canceled, or annihilated) and remains in force until it is repaid - the well known principle of charge conservation. If symmetry debts did not have this "buy now, pay later" character, there would be no explicit time dimension and no manifest world. The "interest" on this loan is gravitation, the energy withdrawn from the intrinsic motion of light and the expansion of spacetime, which funds the symmetry debt of mass by physically creating the time dimension from the gravitational inflow of space.¡P¿ The reason why symmetry debts are quantized remains a mystery, but spacetime must have some method of keeping its energy accounts, and it evidently prefers to do this exactly as we would, by counting in discreet and simple units. But we are children of the Universe; why should its methods and preferences not seem familiar to us? We can only surmise that quantification is the simplest sufficient method of accounting available to the conservation domain.¡P¿ Time and gravitation always appear together, both engendered by mass. This one-way dimension and one-way dimensional force are more than coincidentally connected. Gravitational energy is required to bring the time dimension into its explicit form; gravity is the energy source for time, just as light is the energy source for space.¡P¿

¡h3¿¡A name="interval"¿Time, Gravitation, and the Interval¡/A¿¡/h3¿ The Interval is Einstein's mathematical formulation of a quantity of spacetime that is invariant for all observers regardless of their motion, uniform or accelerated. It is the analog of the Pythagorean theorem in 4 dimensions. The Interval of light is zero, which means it is non-local, and is the fundamental symmetry condition of light. Light could not create its spacetime conservation domain, nor gauge its metric (which amounts to the same thing) without this symmetry condition. But the Interval of mass, or bound energy, is always some positive quantity greater than zero, and this is because the time dimension is necessarily explicit for mass, for reasons of energy conservation we have considered above. ¡P¿

This all makes sense when we think about space filled only with light - here there is no purely spatial Interval because there is nothing to distinguish one place or point from another - all is uniform, indistinguishable, spatial and energetic symmetry. But enter mass and with it its inevitable companions, time and gravitation, and immediately we can distinguish a point or place - here is the particle, more importantly, here is the gravitational field pointing to the particle's location from every other place in space (the influence of the field is universal in extent). But one more thing is needed to pin down this location as absolutely unique: because the universe is always moving, either expanding or contracting, the time dimension is also required to specify which of an endless succession of moving locations in space we are to consider. ¡P¿ The positive interval of mass is not just a mathematical abstraction of geometry; it is a dimensional, energetic reality defined by gravitation, time, and energy. The positive Interval, therefore, represents a dimensional asymmetry because it is unique, distinguishable, and invariant; it is the "location" asymmetry of the gravitational charge, producing Einstein's warpage of the metrical field of spacetime. Light has no associated gravitational field because it has no "location"; its zero Interval is precisely the symmetry condition necessary to prevent the formation of an explicit time dimension and a gravitational field. Light could hardly function as the metrical gauge of spacetime if it were itself plagued by a metric-warping location charge.¡P¿

This is the basic conservation reason why the intrinsic motion of light - whatever its actual numerical value - must be the velocity of non-locality, the velocity of metrical equivalence between time and space, effectively an infinite velocity within its domain. Otherwise light would have a location charge, a time dimension, and a gravitational field, and spacetime would immediately collapse into a black hole. ¡P¿

The source of gravitational energy is the same source that sets the photon in flight. Whatever "inertial force" causes the intrinsic motion of light also causes the intrinsic motion of spacetime we call gravitation. In both cases this "inertial force" is the manifestation of spacetime's conservation role. When light becomes bound energy, it of course looses its intrinsic motion. This loss is simply transferred to the intrinsic motion of spacetime (gravitation), one intrinsic motion for another, one symmetrically expansive, the other symmetrically contractive. We identify this mysterious "inertial force" as entropy (see: "¡A HREF="thermo.html"¿Entropy, Gravitation, and Thermodynamics¡/A¿").¡P¿ In terms of conservation, in obedience to Noether's theorem, bound energy stores the symmetry of light as the conserved charges of matter; in obedience to the first law of thermodynamics, bound energy stores the raw energy of light as mass; in obedience to the second law of thermodynamics, mass stores the entropy of light as its gravitational field. In turn, the gravitational field produces the time dimension of mass. Thus entropy produces the dimensional conservation domains of both free energy (space - through the intrinsic motion of light), and of bound energy (time - through gravitation, the intrinsic spatial motion of mass). This is the iron linkage between the first and second laws of thermodynamics. Noether's theorem is drawn into this web because velocity C is also a symmetry condition and gravitation is also a symmetry debt. (See: ¡A HREF="energy.gif"¿"The Energy Triangle"¡/A¿). ¡P¿

¡h3¿¡A name="quarks"¿Quarks and Leptons¡/A¿¡/h3¿ Mass assumes quantized, specific, particulate form as the strong force hadrons and quarks, and the weak force leptons. Hardons are defined as particles containg quarks; hence all hadrons carry "color" charge, the source of the strong force. Leptons contain no quarks and hence no color charge. Leptons carry lepton "number" or "identity" charge, the source of the weak force. The leptons are true elementary particles whereas the quarks are sub-elementary. Electrons are familiar examples of the massive members of the lepton family (electron, muon, tau, and leptoquark); neutrinos are massless members of the lepton family (there is a separate and distinct neutrino for each massive lepton). Protons and neutrons are familiar examples of the "hadron" family; they are called "baryons" because they contain 3 quarks. The only other hadrons are the mesons, which are composed of quark-antiquark pairs (see the ¡A HREF="partable"¿Particle Table¡/A¿).¡P align=center¿ ¡B¿Quarks¡/B¿¡P¿

In contrast to the electrical and gravitational forces, which have an infinite range through spacetime, the strong force is an internal characteristic of nuclear matter. Baryons are familiar to us as neutrons and protons, but there are many other 3 quark combinations possible using the heavier members of the quark family. Six quarks are known in three "energy families"; the quarks are named "up, down; strange, charm; and bottom, top". ¡P¿

All quarks carry partial electric charges (either +2/3 or -1/3) and their distinguishing charge, color. There are 3 color charges, red, green, yellow (not actually colors, just names of convenience) which are exchanged between quarks by the gluon field; each gluon is composed of a color x anticolor charge pair. One of the nine possible combinations of color x anticolor is doubly neutral, leaving 8 effective members of the gluon field. The constant "round-robin" exchange of the gluons is the mechanism which binds the quarks together. The baryon is a miraculous, miniature universe of structure, information, charge, and activity.¡P¿

Being composed of color x anticolor charges, the gluon field as a whole sums to zero, a crucial symmetry property. Quarks are permanently confined by gluons to meson or baryon combinations; they never occur alone or in any other combination. Finally, only quark combinations which electrically sum to zero or unit electrical charge are allowed. ¡P¿

Quarks are sub-elementary particles, as they carry electrical charges which are fractions of the unit electric charge of the leptons, the only truly elementary particles. When one considers the properties of a baron, it is hard to escape the impression that this is what a lepton would have to look like if it were somehow fractured into three parts. Since, by definition, you cannot "really" fracture an elementary particle, perhaps you could do so "virtually", provided the parts could never become "real", that is, separated, but remained forever united in combinations that sum to elementary leptonic charges. In this way, the fractured particle would still "look like" an elementary paricle to the outside observer; nature is not above such tricks, as we have learned from the virtual particles and Heisenberg.¡P align=center¿ ¡B¿Hadrons and Leptons¡/B¿¡P¿

Collectively, the hadrons and leptons, which comprise the material component of atomic matter, are known as "fermions". All fermions have a "spin", or quantized angular momentum, in 1/2 integer units (1/2, 3/2, etc.); fermions obey the Pauli exclusion principle, which simply states that no two fermions can be in the same place at the same time, if all their quantum numbers are also the same. Fermions cannot pile up on top of one another indiscriminately; they keep their own counsel, which is why we get specific atomic structure rather than goo. In contrast to the fermions is the class of energy forms known as "bosons", which includes the force carriers or field vectors: the photons of electromagnetism (the quantum units of light), the gravitons of gravity, the gluons of the strong force, and the IVB's of the weak force. Together, the fermions and bosons comprise the particles and forces of matter. Bosons have whole integer spins (1, 2, etc.) and they can and do superimpose or pile up on one another. Thus a photon or graviton can have any energy because it can be composed of an indefinite number of superimposed quanta, whereas an electron has a single, specific rest energy. ¡P¿

If we add the charges, or symmetry debts, of matter to the fermions and bosons, we have a complete list of the known energy states. Fermions carry charges which produce forces whose field vectors are bosons.

Thus massive leptons and quarks bear electric charges whose field vectors are photons; a neutrino, baryon, leptoquark, and massive leptons bear identity charges whose field vector is the W; all quarks bear a color charge whose field vector is a gluon; all forms of mass bear a gravitational charge whose field vector is the graviton.¡P¿

Once again we have a natural dichotomy which invites our curiosity, experiment, and speculation. What is the relationship between the quarks and leptons? They seem made for each other - are they indeed made by each other - perhaps both arising from a common ancestor?¡P¿

We speculate that the ancestral particle of the quarks and leptons is the "leptoquark", the heaviest member of the leptonic elementary particle series. The leptoquark is a lepton at high energy densities, when its quarks are compressed so tightly that its color charge vanishes through the principle of "asymptotic freedom". At lower energy densities, the quarks expand under their quantum mechanical and electrical repulsion, causing the color charge to become explicit. Through the internal expansion of its 3 quarks, the leptoquark becomes a baryon, decaying eventually to the ground state proton, producing leptons (via the W) along the way, which function as alternative charge carriers for both electric and identity charge.¡P¿ ¡P align=center¿ ¡B¿Neutrinos¡/B¿¡P¿

Neutrinos are massless leptons with intrinsic motion C. Neutrinos are the explicit form of lepton number charge, which is hidden or implicit in the massive leptons (and also in the massive baryons and leptoquark). Three massive leptons are known, the electron, muon, and tau, a quantized mass spectrum of elementary particles, identical except for mass and identity charge. The leptoquark is the presumed 4th member of this series, the heaviest of all, distinguished from the others by its fractured interior. ¡P¿

Each massive lepton is associated with a specific neutrino, or number charge, which I refer to as an "Identity" charge to acknowledge the symmetry debt carried by this charge. All photons are indistinguishable one from another, but the leptons do not share this "symmetry of anonymity". While all electrons are identical, they are distinct from the photon, and from the other elementary particles - the muon, tau, and leptoquark. Neutrinos are the hallmark of an elementary particle; they are telling us that there are only four; all else is a composite. The conservation domain requires this identity asymmetry to be recognized and accounted for, but it is economical in its bookeeping, concerning itself only with massive elementary particles. All neutrinos have left-handed spin, while all antineutrinos have right-handed spin, neatly distinguishing the leptonic series from its antimatter counterpart. Evidently these specific "identity" charges function to facilitate annihilation reactions between matter and antimatter, allowing the various particle species to identify their proper "mates". Through the facilitation of annihilation reactions, the identity charges make their contribution to conserving light's symmetry.¡P¿

Because the massless neutrinos have intrinsic motion C, they, like the photon, are embedded in the fabric of spacetime as vibrations of its dimensional structure, quanta of information advising spacetime of the identity and number of all elementary particles within its domain. Combined with the metrical warpage of gravitation, we see that spacetime contains an actual structural "knowledge" of the location and identity of every massive elementary particle. This startling fact should bring home to our awareness that spacetime is as scrupulous concerning symmetry conservation as it is concerning raw energy and entropy conservation. Not only is every hair on your head numbered, but even every elementary particle in that hair is numbered and its location known. "Every jot and tittle of the law will be fulfilled." ¡P¿

¡h2¿Row 3 - ¡A name ="row three"¿Charges¡/A¿: The Symmetry Debts of Light¡/h2¿ ¡h3¿Electric Charge¡/h3¿ This is the row of particle charges, carried by matter produced when the weak force breaks the symmetry of particle-antiparticle pairs at the conclusion of row 1. Charges are conservation effects, in particular the conservation of symmetry. The charges of matter are the symmetry debts of light. Charge conservation is symmetry conservation; the forces generated by these charges are the demand for repayment of the symetry debt. ¡P¿

Charges arise naturally from the process of symmetry breaking. When particle-antiparticle pairs are created from light, each member of the pair carries various charges which function to ensure instant and successful annihilation, reconstituting the light from which they were created. Since light itself carries no charges, it can only create particle pairs whose charges balance, summing to zero. The electric charge is prototypical of this effect. ¡P¿

Initially, all massive elementary particles are created in particle-antiparticle pairs with equal but opposite electric charges summing to zero. These opposite charges attract each other powerfully, allowing the particles to find each other in space and recombine, producing the annihilation reaction which returns their energy to light, conserving the symmetry state of the free energy which created them. Since photons, or light quanta, are the field vectors (force carriers) of electric charge, we see light actively protecting its own symmetry in annihilation reactions through the forces generated by electric charge.¡P¿

When one member of a particle pair is isolated, as by the asymmetric decay of matter-antimatter pairs during the Big Bang, the charges of the remaining pair member, which were intended to motivate and facilitate an annihilation reaction with its antimatter partner, are simply ”hung” in time. The remaining particle is one-half of a symmetric particle-antiparticle pair, one-half of light’s symmetric particle form, and its charges can therefore be characterized as the ”debts” of light’s broken symmetry.¡P¿

We do not ordinarily realize that the symmetry of energy is conserved as well as its total amount, but it has been known for a long time that this must be true. In a famous theorem, Emmy Noether proved mathematically that in a multicomponent field, such as the electromagnetic field, wherever there is a symmetry one also finds an associated conservation law, and vice versa. This theorem has become the mathematical basis for modern efforts to unify the forces. In the model presented here, I trace the unity of the forces back to their origins as the conserved debts of light’s broken symmetry. ¡P¿

While electric charge is always associated with mass, it is independent of the quantity of mass; the three leptonic particles (electron, muon, and tau), for example, have vastly different masses but carry the same electric charge. Electric charge is not associated with particles which have intrinsic motion C, such as the neutrinos, even though neutrinos are asymmetric in other respects, such as spin, handedness, and identity. There is definitely a major, general asymmetry associated with the loss of light’s intrinsic motion which electric charge is powerfully guarding against, and we would like to distinguish it from the asymmetry associated with the gravitational charge, which is obviously also generally related to mass and its lack of intrinsic motion.¡P¿

The asymmetry I single out as the target of electric charge is dimensional - light is 2-dimensional, mass is 4-dimensional. Light lacks the x, t dimensions of bound energy, as Einstein discovered. The jump from 2 to 4 dimensions in the conversion of light to particles is a general loss of symmetry since the 4th dimension inevitably includes time, which is an asymmetric, one-way dimension. It is this particular asymmetry, time, which electric charge protects against. Electric charge, through matter-antimatter annihilations, protects light’s dimensional symmetry by preventing light from devolving into matter and the asymmetric time dimension which is matter’s conservation domain.¡P¿

¡h3¿¡A name=”global”¿Gravitational Charge¡/A¿¡/h3¿ Gravitation is a ”spacetime” charge, at once the most common and familiar, but perhaps the most mysterious and intractable to explain. Yet its role seems clear enough; gravitation reduces the expansion rate of spacetime in response to the loss of free energy producing that expansion, as when light is converted to particles, or any other form of bound energy. Light has intrinsic motion in space, which produces the expansion of spacetime; indeed the intrinsic motion of light produces spacetime itself. Particles (or bound energy generally) have no intrinsic spatial motion. This form of energy cannot produce spacetime much less cause its expansion. Instead, bound energy has intrinsic motion in its own conservation domain, time.¡P¿

The symmetry debt associated with gravitation is ”location”. When light is converted to mass, light loses its intrinsic motion and hence its non-locality. Whereas light is everywhere simultaneously within its conservation domain (Interval = 0), mass has ”intrinsic rest” and acquires a positive Interval. The distributional symmetry of light’s energy within spacetime is broken; mass is a concentrated lump of energy with a specific location in spacetime; this location is actually identified in energetic terms by the warped metric produced by the gravitational field of mass. Whereas light is 2-dimensional, mass is 4-dimensional; the acquisition of the extra dimensions, especially T, identifies the spacetime coordinates and specific location of mass. ¡P¿

But the gravitational charge is unusual in that it is more than just a symmetry debt. Unlike electric charge, color, or number, it is related to mass (Gm), energy conservation, and entropy conservation. The gravitational force creates the time dimension which mass requires for its conservation domain, converting space to time, and is also the expression of entropy in matter. The gravitational force is essentially the intrinsic motion of light (the entropy function of light), conserved and expressed in mass in negative form, the entropy debt of light. Gm = the entropic energy of mass, and is the exact negative of the entropy associated with the free energy which created M - (MC2). The complexity of gravitation is due to the fact that its conservation function addresses the first and second laws of thermodynamics, through time and entropy, as well as symmetry conservation, through location and the positive interval, simultaneously. The active principle of the gravitational charge is time. For a complete discussion of the gravitational charge and its mechanism, see the companion paper on this website: ¡A HREF=”thermo.html”¿”Entropy, Gravitation, and Thermodynamics”.¡/A¿¡P¿

¡h3¿¡A name=”color”¿The Strong Force Color Charge¡/A¿¡/h3¿

Quarks are sub-elementary particles, as we know from their fractional electrical charges which are either 1/3 or 2/3 of the unit charge carried by elementary particles such as the electron. Allowed quark combinations always sum to zero or unit leptonic values of electric charge: the proton is +1, the neutron 0, mesons are 0, +1 or -1. The symmetry which the strong force is protecting is this quantum unit of electric charge, the elementary leptonic charge. If quarks were not confined as they are, there would be no way to annihilate or even neutralize their partial electric charges, or other partial charges they may carry. Symmetry could not be restored and conserved in such a case. The strong force protects symmetry by confining these sub-elementary particles into quantum unit packages of charge which can be neutralized and annihilated by other elementary unit charges. The strong force presents us with an interaction between the quantum mechanical requirement of unit charge and the necessity of symmetry conservation. ¡P¿

If one were to fracture an elementary particle into 3 parts, but require that when it became ”real in time” it must retain its ”virtual” leptonic character in terms of charge, one would require a confining force with exactly the characteristics of the strong force as produced by the color charge.¡P¿

The two ”particle forces”, strong and weak (the ”short range” forces), form a symmetric-asymmetric force pair which are essential to the creation of matter. In this regard, they are provocatively similar to the symmetric-asymmetric ”long range” force pair of spacetime, electromagnetism and gravitation.¡P¿

¡h3¿¡A name=”number”¿The Weak Force: Lepton ”Number” or ”Identity” Charge¡/A¿¡/h3¿ The leptonic charge is known as ”number” charge. I prefer to call it ”identity” charge, a name which better reflects its reason for existence. Photons (individual light quanta) are indistinguishable and anonymous. They are all alike, and hence form a symmetry of identity. Particles, on the other hand, are not all alike; they are distinguishable as to type. ¡P¿

We know of three distinguishable elementary particles, the leptonic spectrum or series, electron, muon, and tau, differing in their masses which increase from electron through muon to tau. Each has a specific neutrino associated with it, a massless particle traveling at velocity C, which carries leptonic number (”identity”) charge. ¡P¿

The leptonic series has the appearance of a mass quantum series - that is, these elementary particles are always created with a specific, discreet mass and no other; there are no elementary massive particles in the gaps between their mass units, much like the discreet gaps between energy levels of atomic electron shells. The neutrino that is associated with each is evidently the hallmark of the truly elementary particle (the sub-elementary quarks have no associated neutrinos). ¡P¿

It seems likely, however, that there is an undiscovered neutrino associated with the ancestral particle which gave rise to the baryons, which I assume to be the heaviest member of the leptonic series, the so-called leptoquark. If we ever see proton decay, we would expect to see this neutrino produced in the process.¡P¿

The number charge evidently facilitates the annihilation process, identifying the several types of elementary particles, and by the handedness of their spins neatly distinguishing matter particles from their antimatter counterparts. Neutrinos also comprise a type of accounting system, informing spacetime (since they travel at C) of the number and identity of elementary particles (or antiparticles) contained within its domain.¡P¿

Identity or number charge plays a special role in the creation of the material universe. We can characterize the light universe, before the creation of matter, with just 2 numbers representing its symmetric charge state: Interval = 0, and Number = 0. After the creation of matter, both symmetries are broken and become positive: Interval gt; 0, and Number gt; 0. (Electric charge is zero both before and after the creation of matter, while color is an internal property of baryons). The positive interval represents gravitation, the positive number charge represents particles. The metric universe, the universe of the spacetime conservation domains, responds to the positive number asymmetry by providing an asymmetric temporal conservation domain for particles through gravitational action.¡P¿

The universe manifests through the identity charge, as identity provides a basis for the interaction between the symmetric quark field and the asymmetric leptonic field. It is through the identity charge that the leptonic field separates leptoquark from antileptoquark, and sets them upon separate asymmetric decay pathways, breaking the symmetry of their particle-antiparticle pairs. The fact that the fields interact electrically is not sufficient to break the symmetry, since the electrical field is also perfectly symmetrical. It is for this reason that we feel the leptoquark neutrino must exist. For a complete discussion, see: ”¡A HREF=”origin.html”¿The Formation of Matter and the Origin of Information¡/A¿”. ¡P¿

¡h2¿Row 4 - ¡A name =”row four”¿Field Vectors¡/A¿: The Force Carriers as Symmetry Payments¡/h2¿ ¡h3¿Photons - The Electric Force¡/h3¿ The electrical symmetry debt can be repaid in two ways, either by neutralization or by annihilation, since unlike gravitation, electric charge is bipolar rather than monopolar. Whereas the gravitational symmetry debt can only be repaid by the conversion of mass to light, electric charge can be neutralized by its opposite matter charge, as well as annihilated by its antimatter charge. Electric charge acts to prevent the formation of bound energy; failing in this, it seems to have little further ability to restore symmetry, other than an eternal readiness to motivate an antimatter annihilation if the opportunity arises. Instead, electric charge contents itself with neutralizing opposite matter charges, and confining them to small regions of spacetime, which ”pays down” its symmetry debt as far as it can. Gravitation does not act to prevent the formation of bound energy, but once formed, seems to have a real ”plan” for its ultimate destruction - not ”divide and conquer”, but ”collect and conquer”. In this we discern the entropic character of gravitation,in contrast to any other symmetry debt.¡P¿

The field vector of electric charge is the photon, the quantum unit of light and the electromagnetic force. In the annihilation of matter-antimatter particle pairs, we see the photon protecting its own symmetry. Electric charge is bipolar, consisting of opposite charges which attract each other powerfully over an infinite range of spacetime. The strength of this arrangement is that it permits matter-antimatter pairs to find each other, no matter how far they may be separated. The weakness of this arrangement is that electric charges can neutralize as well as annihilate each other. It is therefore possible for a composite particle like the baryon to arrange the partial charges of its quarks to a neutral electrical configuration, as in the neutron. It is just this weakness that is exploited by the weak force to produce the asymmetric decays of neutral leptoquarks and produce an excess of matter in the Big Bang. This is the fundamental reason why a composite particle is necessary if matter is to be extracted from the primordial symmetric energy state of the Cosmos.¡P¿

Once matter is formed, electric charge can do little to restore the symmetric state of energy because its force is quenched by its ability to neutralize itself. The net electric charge of the Cosmos is zero, both before and after the creation of matter. In chemical reactions, electric charge will drive toward the lowest bound energy state, but chemical releases of energy are insignificant compared with the total energy content of matter. ¡P¿ Electric charge, however, in the form of the electron shell of atoms and the interplay of electrical and magnetic forces, is instrumental in building a negentropic information pathway which culminates in biological systems and the rise of consciousness. In this, electric charge seems to be attempting to reconstruct the original connectivity of light, even if it cannot reconstruct its symmetry. The primordial system of light was not only a wholly symmetric, but also a wholly connected entity. Electric charge, whose field vector is the photon, can be thought of not only as a debt of light’s symmetry, but also as a debt of light’s connectivity, the holistic (”holy”) character of the primordial energy state. Hence electric charge seems to function as a ”memory” of a preexisting state of connectivity as well as symmetry. ¡P¿ Although it cannot restore symmetry chemically, electric charge nevertheless attempts to reconstruct connectivity in material systems by means of a chemical information pathway. For example, biology is nothing if not a web of interconnections, and through the evolution of conscious information systems, humans have not only become aware of the essential connectivity of the Cosmos, both intuitively (”spiritually”) and rationally, but are now engaged in the process of extending this physical web of connection between the planets of our solar system, and on into the galaxy. For a more detailed examination of the evolution of this network, see: ”¡A HREF=”path.html”¿The Information Pathway¡/A¿”.

¡h3¿¡A name=”gravitons”¿Gravitons - Gravitation¡/A¿ ¡/h3¿ If we are to believe Einstein, gravitons, the field vectors of gravitation, must couple directly with the dimensional structure of spacetime. This coupling is attractive only, without a repulsive counterpart, as in electricity. The effect is to ”warp” or ”bend” spacetime, reducing the local gauge of the metric - the magnitude of the electromagnetic constant C. Time and space are affected in metrically equivalent terms. It may be difficult to imagine how anything could couple to something so intangible as a dimension, yet this is certainly the best explanation we have.

And the dimensions are not so intangible when we encounter them through inertial forces (forces felt during acceleration); the intrinsic motion of time, the intrinsic motion of light, and gravitation itself can also be considered inertial forces in that they are all dimensional expressions of energy conservation.¡P¿

A dynamical view of gravitational action is allowed by Einstein's equations, via the equivalence principle. We are free to view a reference frame as either at rest in a static gravitational potential (as on the surface of the Earth) or as accelerated in spacetime by an equivalent positive force. Hence we can view gravitation as the accelerated motion of spacetime itself, rather than as a static metrical tensor. It seems to me this dynamic view offers a physically simpler way to visualize gravitational action, and leads to other insights as well.¡P¿

The equivalence principle follows from the notion that we cannot distinguish between moving ourselves through spacetime or spacetime moving itself through us. In the dynamic view, all objects fall with the same acceleration not because the static potential is the same but because they are carried along in the same flow of spacetime. Similarly, velocity C and the local metric are reduced simply by the subtractive effect of the physical flow of spacetime; co-movers with the flow are of course unaware of its motion - all the ordinary gravitational effects are as readily explained by one view as the other. ¡P¿

For example, the gravitational contraction of the universe comes about simply through the shifting balance between the quantity of inward vs outward flows of spacetime. Mechanically, the symmetrically opposing flows of spacetime toward a gravitational center of mass simply cancel themselves out: x in one direction cancels -x in the other direction, where they meet at the center of mass, and so forth with y and z. The energy content they carry with them is simply left behind, deposited on the surface, say, of an accreting planet. This furthermore explains why gravitation must be a spherically symmetric force, since the dimensions will not otherwise cancel each other.¡P¿

And what about time? T, being one way by the conservation of energy, does not cancel; there is no -t as there is -x, -y, and -z. Yet because of the metrical equivalence of space and time, if we destroy space we must have time left over as a residue. Hence mass acquires an exact metrically equivalent intrinsic motion in time since t remains uncanceled while the other dimensions self-annihilate. The universal gravitational constant G is thus precisely linked with both T and C, because G extracts T from its metrical equivalent, space. ¡P¿

¡h3¿¡A name="shunt"¿The Time Shunt¡/A¿¡/h3¿ This view opens a new conceptual realization/possibility concerning the relationship between time and gravitation. Stated directly, it is that the opening of the time dimension allows space to be "shunted" into an alternative, metrically equivalent dimension, and it is this diversion of space into the time dimension which is the actual mechanism by which the spatial volume of the universe is decreased by gravitation. In other words, the space we feel accelerating toward us on the surface of the Earth (which we perceive as the gravitational pull, weight, or force) is just the space that Earth's gravity is shunting (one way) into Earth's (one way) time dimension. The actual spatial volume of the universe is reduced in consequence, producing the contractive effect of gravitation. The fact that this reaction is possible at all accrues from the metrical equivalence of time and space, elucidated by Einstein. Earth's gravity is creating Earth's time dimension through the conversion of space to its metrical equivalent, time.¡P¿

When the photon's intrinsic spatial motion ceases as it is captured by, or converted to, bound energy forms, its spatial metric component is transferred to its equivalent temporal component. Time acts as the active principle of the gravitational "location" charge, identifying an asymmetric location within symmetric space, and attracting space towards itself. The intrinsic motion of the photon continues as the gravitational field of matter, matter's intrinsic motion in space. Thermodynamically, the positive entropic flow of light (light's intrinsic motion) is transferred and conserved as the negative entropic flow of matter (matter's gravitational field).¡P¿

This very simple picture accounts for the association between gravitation, time, and mass, and the notion that gravitation is the energy source for time, just as light is the energy source for space. Most importantly, through the principle of equivalence, it is fully in accordance with Einstein's equations, and the thermodynamics of energy and entropy conservation.¡P¿

The metrical equivalence of space and time is one of the most astounding facts of Einstein's relativity. We trade space for time whenever we move, but usually we move so slowly in comparison to the metrically equivalent value (186,000 miles/second) that we do not notice the exchange. If we could move at C we would completely exchange space for time, and our personal clocks would stand still, like the photon's.¡P¿

¡h3¿¡A name=”quantum”¿Quantum Radiance¡/A¿¡/h3¿ Like the other symmetry charges, gravitation has a symmetry debt to pay, and like the other charges, if gravitation cannot pay the debt off outright, it will always move in that direction by at least ”paying it down” as much as possible. Since an atom or a planet can have the same center of mass, or location, the gravitational concentration of massive particles reduces the number of individual location charges, confining them to as small a volume as physically possible. If enough mass is accumulated, the fusion reactions of the nucleosynthetic pathway are initiated, converting a portion of the bound energy to light, a direct payment of the symmetry debt. But this process can only go so far, as baryon (lepton) number conservation prevents the great bulk of any stellar mass from converting to light. But gravitation drives on, collapsing the electron shells of atoms in white dwarfs, and finally driving this ”electron sea” into the protons, forming neutron stars, essentially gigantic atomic nuclei held together by gravitational forces. Still unsatisfied, if enough mass is present, gravitation collapses even nuclear matter to the singularity of a black hole, surely the most bizarre and fearsome object in the universe. ¡P¿

In the creation of a black hole, gravitation reaches its goal, for as Stephen Hawking has shown, through the principle of ”quantum radiance” the total mass of a black hole will eventually be converted to light. The defining feature of a black hole is that the gravitational acceleration of spacetime reaches C. As in the venerable saying, ”the extremes meet”: matter began as light with intrinsic motion C; matter ends by itself achieving intrinsic motion C through the gravitational acceleration of spacetime, a total reversal of the roles of intrinsic motion. But this full circle regenerates matter as light again, the back-handed symmetry solution of gravitation paying positive dividends in the end, an amazing story of purposeful and relentless symmetry conservation which no one would believe if Einstein's and Hawking's mathematics were not there to prove it.¡P¿

In thermodynamic terms, the conservation of light's entropy (light's intrinsic motion) as the gravitational field of matter reaches a limiting case in the black hole. Because at the Swartzchild radius the inflow of space is already at velocity C, it is not physically possible to simply continue increasing the strength of the field as matter is added to the hole. Therefore, the only accommodation possible is to increase the size of the surface over which this maximum spatial flow is realized, resulting in the Hawking-Bekenstein theorem relating the entropy of a black hole to its surface area. Since gravity is creating the time dimension for the mass of the hole, the constraint on the entropy expression also applies to the expression of the time dimension. The volume of space occupied by a black hole can therefore be viewed as a displacement of space by the time dimension, exactly as a ship displaces water. Hence while the surface area of a black hole is proportional to its entropy, the volume of a black hole is proportional to both its time dimension and its mass. (See: ”¡A HREF=”http://thermo.html”¿Entropy, Gravitation, and Thermodynamics¡/A¿”).

¡h3¿¡A name=”gluons”¿Gluons - The Strong Force¡/A¿¡/h3¿

In addition to its important role in confining quarks to elementary whole-quantum charge units, the strong force contains a crucial internal symmetry. The color charge of the strong force consists of three parts, called (for convenience only) red, green, and yellow. Each quark carries one color charge, which it swaps with its neighbors in a ceaseless round-robin exchange by means of an internal field of ”gluons”. Gluons are virtual particles, massless and moving at velocity C, the bosons or force carriers of the color charge and strong force. They have been compared to ”sticky light”. Each gluon is composed of a color-anticolor charge, in every combination, hence there are nine of them, except one is doubly neutral (green-antigreen), leaving eight effective charge carriers. Because the gluon field is composed of color-anticolor charges, it sums overall to zero color. The gluon field is internally confined to baryons and mesons, the class of particles known as ”hadrons”, defined as all particles containing quarks. (There is enough ”leakage” of the gluon field to allow color-sharing between nucleons, allowing the building of compound atomic nuclei).¡P¿

Physically squeezing the quarks together has the effect of summing up the gluon field, so that as quarks crowd together, the strong force relaxes and the quarks move more easily with respect to each other. This effect is known as ”asymptotic freedom”. In the limit, if the quarks are fully compressed, the color charge sums to zero and vanishes. This is the configuration of the leptoquark, and is the condition of ”color symmetry” which is necessary for proton or leptoquark decay. Quarks repel each other electrically and through other quantum mechanical forces (exclusion principle); as they do so, the color force becomes explicit, limiting their expansion. Because the color charge is conserved, the weak force cannot cause baryon decay while the color charge is explicit. But if for some reason the color charge should self-annihilate (as in the extreme pressures of the Big Bang or a black hole), the leptonic decay of a baryon can go forward via the W. It is this effect that allows the weak force decays of neutral leptoquark-antileptoquark pairs during the Creation Event. Again, the ”summing to zero” of the color charge is exactly what we would expect of an internally confining field arising from the fracturing of an elementary particle which initially contained no color charge at all - in other words, a fractured, heavy lepton.¡P¿

”In the limit” the color charge vanishes. This limit probably translates physically to ”leptonic size”; in this condition, with no color charge present, a baryon is indistinguishable from a heavy lepton, reverting to its ancestral form, the ”leptoquark”. This particle is useful for energy storage or ”packaging” at high energy densities, since the quarks can store extra energy like a set of compressible springs. This is probably the ”practical” reason for the origin of this particle. When fully compressed, the leptoquark is a lepton and the color charge is implicit; when the pressure is relieved, the color charge becomes evident or explicit, and it is a baryon. As a lepton, it must have an associated neutrino, but as a baryon, this neutrino cannot cancel the explicit color charge. Thus the baryon is stable against ordinary leptonic decays in its normal state. Only when the quarks are fully compressed, vanishing the color charge, does the baryon return to its leptonic ancestral state, and proton decay becomes possible via the W and the leptoquark neutrino. ¡P¿ Presumably, all baryons have one and the same number charge, as all stem from the single leptoquark ancestor, and all must revert to this same high-energy form to decay, resulting in the extraordinary stability of the proton. It seems likely that only the gravitational pressures of a black hole can provide sufficient symmetrical force to routinely cause proton decay. If this is so, then the interior of black holes may consist of nothing but gravitationally trapped light, a condition strangely reminiscent of the gluons or ”sticky light” trapped within a baryon.¡P¿ The strong force acts to restore light's symmetry through nuclear fusion, resulting in the creation of the heavy elements in the nucleosynthetic pathway of stars. This pathway, however, is relatively short and ineffective, as only a small fraction of the energy stored in baryons can be released through nuclear fusion. Proton decay completely converts nuclear mass to light, but the process is so rare that the proton, in human terms, is virtually eternal. We owe the stability of matter to the great strength of the strong force and the huge mass-energy of the leptoquark. But the seeds of its own destruction are contained within the baryon, through the principle of asymptotic freedom and the self-annihilation of the color charge.¡P¿

¡h3¿¡A name=”ivbs”¿The Weak Force IVBs: Fission, Identity Charge¡/A¿¡/h3¿

Because it is the weak force which breaks the symmetric state of energy in the Creation Event and brings the material Universe into existence, we might not expect this force to be particularly active in returning the material system to symmetry. Yet, the force that creates matter can also destroy matter, and it does so in several ways - through the decay of heavy particles to their ground state, through the fission of heavy compound nuclei, through contributions to fusion in the nucleosynthetic pathway of stars, and through the process of proton decay, for which it provides the annihilating identity charge.¡P¿

When we consider an elementary particle, such as the electron (e-), we often forget that this particle carries two charges, electric charge and identity (or ”number”) charge. The electric charge is indicated by the negative sign, the identity charge is indicated by the ”e”. We say that identity charge is ”hidden”, or carried in implicit form, by the massive electron, but is revealed in its explicit, massless form as the electron neutrino. (Whether or not the neutrino is actually massless has nothing to do with its symmetry debt of identity. I will continue to assume the neutrino is massless (because of its lack of electric charge), until firm evidence is found to the contrary). Usually the identity charge is simply called lepton or baryon ”number” charge, which obscures the true meaning of this charge. If ”number charge” adequately described its function, then the number charge of the electron would also serve as the number charge of the muon and tau; but as we know now, there is a specific and distinct neutrino associated with each member of the elementary leptonic spectrum, so the charge is more accurately described as ”identity”. Moreover, we can readily assign ”identity” as a plausible symmetry debt of light's anonymity, with a sensible function to perform in annihilation reactions (facilitating the choice of the correct antimatter partner), arguments and contact with Noether's theorem which we cannot make for the generalized ”number” charge.¡P¿

It is at first a curious fact, and then after reflection, an obvious one, that the identity charge is the key to manifestation. It is identity that brings matter into existence, as the principle or ”cardinal” symmetry debt. But then, how could it be otherwise? Identity is the key asymmetry of information, the essential ingredient that must be isolated from the symmetric field of energy if manifestation is to occur. ”In the beginning was the Word”; the word carried information, and the information was ”identity”. Do we not spend our entire lives discovering the personal meaning of identity?¡P¿

The lepton field of elementary particles functions as alternative charge carriers, both for the symmetric, composite field of the quarks and hadrons, and for its own members. The massive leptons function as alternative carriers of electric charge, the massless neutrinos function as alternative carriers of identity charge. Without this service, the symmetric quark field could not manifest, since in the absence of leptons, quarks could only balance their charges with antiquarks, and they would remain forever locked in mutually annihilating particle-antiparticle pairs. Without neutrinos, the massive leptons would likewise remain locked in their particle-antiparticle pairs, themselves lacking an alternative carrier of identity. Hence it is that the neutrino, the least of all particles, becomes the "mouse which nibbles the lion's net", provides an alternative, conserved, carrier of identity charge, unleashing the information potential of the Cosmos.¡P¿

Just as we see the information pathway of the electromagnetic force evolving to reestablish the primordial connective unity of light throughout material systems, so we see through the rise of consciousness and the emergence of organisms with definite individuality and personality, the reemergence and exploration of "identity" in the material realm. The concept of the "soul" as the essential element of personal identity, hidden in the body but functioning as a conserved, alternative charge carrier which both underlies and permits the manifest experience, is a particularly striking example of the evolution, through the information pathway, of an intuitive awareness not only of our unity with nature, but of the very basis of our physical and cosmic origins.

¡h2¿¡A name="summary"¿Summary¡/A¿¡/h2¿ Bound energy has intrinsic motion in time, not space; light has intrinsic motion in space, not time. Light's "clock" is stopped and bound energy's "speedometer" is stopped. This strange difference in the inertial status of the two principle energy forms of our Universe is the true point of entry into the mysteries of the world, the cleft between the dimensions which should arouse our natural curiosity and which offers a point of leverage for analysis. It is upon this natural opening in the otherwise seamless skin of nature that Einstein focused his investigations with so much success, and which has been the starting point for my own. ¡P¿

What is the meaning of this fundamental difference in the inertial status of free and bound energy? Is it a dimensional difference? How are these energy forms related, physically and evolutionarily? The relationship between light and matter is the fundamental energetic relationship of the physical universe, which we must understand before we can hope to achieve Einstein's dream of a unified field theory.¡P¿

We have learned that light and metrical spacetime create matter in symmetric particle-antiparticle pairs, and that these, through the mechanism of mutually interlocking charges, annihilate each other to recreate the light which formed them. The asymmetric mechanism of the weak force breaks the symmetry of the particle-antiparticle pairs, producing an excess of matter. We have learned that the raw energy of light is stored (conserved) in the mass and momentum of the particles, and that the charges of matter, which appear to be gratuitous from the point of view of raw energy conservation, are in fact necessary from the viewpoint of symmetry conservation: not only raw energy but its symmetric state must be conserved. This interaction occurs within the metric arena of spacetime, the dimensional setting which houses and conserves the energy play. How is spacetime related to this play of light and particles? What is this play about?¡P¿

There is a third side to the ¡A HREF="energy.gif"¿Energy Conservation Triangle¡/A¿ which involves the second law of thermodynamics, entropy. It is through entropy that we are able to complete the conservation linkage between the dimensional structure of spacetime, light, and matter. The entropy of light is expressed through its intrinsic motion, which produces not only spacetime, the conservation domain of light, but its expansion and cooling. The entropy of mass is expressed through its gravitational field, which is the exact negative of the entropy of the light which created mass. Gravity is therefore the conserved form of light's entropy (second law, entropy conservation); mass and momentum are the conserved form of light's raw energy (first law, energy conservation); the charges of matter are the conserved form of light's various symmetries, and constitute the essential information which particles require, in the absence of antimatter, to return to their original symmetric state (symmetry conservation = charge conservation). ¡P¿ Light's entropy (light's intrinsic spatial motion), creates light's dimensional conservation domain, space; matter's entropy (matter's intrinsic spatial motion, gravitation) creates matter's dimensional conservation domain, time. The first and second laws are connected through the entropic creation of the dimensional conservation domains of light and matter. ¡P¿

The cosmic drama begins innocently enough in two dimensions with the entrance of pure light and space. Then a cast of particles appears, in symmetric particle-antiparticle pairs: some heavy, some light, some composite and complex, some elementary and simple, but all related and all derived from the energy of light and the metrical structure of spacetime. They are dressed in various charges which allow them to alternate with blinding speed between their particle and light form, a counterpoint between manifest and unmanifest, a true magic show. But then a symmetry disaster strikes, and the plot literally thickens. Some of the heavy, composite particles of antimatter have reverted to their wave (light) form via the weak force W, without annihilating their matter counterparts. Caught by surprise, the matter particles have no way of reverting to their light form; they are trapped in the 4th dimension of explicit time, whereas before they existed in the virtual realm of two dimensions. We recognize them now as baryons. They are left in their massive forms, one half of light's particle form, with all their charges exposed, charges which had previously functioned to unite them with their antimatter partners and return both to light. These charges are the symmetry debts of light; like Hamlet's father, the baryons have been treacherously thrust into a new realm without the chance to absolve their sins.¡P¿

While the mass and momentum of particles conserves and represents the raw energy debt of light in 4 dimensions, the charges conserve and represent the 2-dimensional symmetry debts of light; these charges are not affected by either time or motion, both attributes of 4-dimensionality. Whereas before we had a simple counterpoint between particle and wave, now we have a complex polyphonic mixture of 2 and 4 dimensional forms which interact with each other, while still obeying the separate inertial rules appropriate to their own dimensionality. Gravitation acts as a mediating force between the conservation domains of light and matter, space and time.¡P¿

Time becomes the dimensional conservation stage upon which the play now unfolds, a negentropic stage provided by the energy of gravitation. Gravitation creates the time dimension through its ceaseless consumption of space. The argument of the play is this: can the particles, using their symmetry charges, either individually or collectively, transform to their light form in the absence of their antimatter partners? Can they reproduce this magical transformation by themselves? The collective process is gravitational, the individual process is proton decay. Both will arrive at the same result, the complete transformation of the particle to light. In the meantime, an electromagnetic information pathway developes which attempts to express or reconstitute in material systems its charge-memory of the connective unity of its primordial symmetric state. The development of personal "identity" and the abstract information systems of humans are emergent products of this evolutionary process.¡P¿

The fundamental nature of energy remains a mystery. What can we really say about energy? Only a few things: 1) its character is electromagnetic; 2) it is conserved in quantity, entropy, and symmetry; 3) it is variable in form; 4) it produces physical reality; 5) its fundamental expression is change; 6) its origin is unknown.¡P¿

When the universe eventually returns to light it will do so with something it did not possess before - the experience of its manifest identity gained through the evolutionary process in the time dimension. Our lives will be part of that experience; we are the eyes and ears, the physical and metaphysical senses of the universe. The meaning of the information pathway that develops through time in the negentropic domain of gravitation is a separate topic which I address at length in another paper (see: ¡A HREF="path.html"¿"The Information Pathway"¡/A¿).¡P¿ ¡h2¿¡A name="appendix"¿Appendix¡/A¿¡/h2¿

¡h3¿¡A name="simple"¿Table of Energy States and Forces¡/A¿¡/h3¿ ¡table¿ ¡TABLE BORDER¿ ¡caption¿¡strong¿ Unified Field Simplified Table ¡/caption¿

¡TR¿¡font size=2¿ ¡td colspan=2¿

¡td align=center¿ ELECTROMAGNETIC

¡td align=center¿ GRAVITATION

¡td align=center¿ STRONG

¡td align=center¿ WEAK ¡/tr¿

¡tr¿ ¡td colspan=2¿¡td colspan=4 align=center¿¡font size=2¿¡strong¿ FORCES ¡/strong¿ ¡/tr¿

¡tr¿ ¡TD align=center¿¡FONT SIZE=2¿ Free Energy¡BR¿Symmetric Forms¡BR¿(Creation Event)

¡td rowspan=4 align=center¿¡font size=2¿¡strong¿ E¡BR¿ N¡BR¿ E¡BR¿ R¡BR¿ G¡BR¿ Y¡BR¿¡BR¿ S¡BR¿ T¡BR¿ A¡BR¿ T¡BR¿ E¡BR¿ S¡BR¿

¡/strong¿

¡TD align=center¿¡FONT SIZE=2¿ Light: E=h¡I¿v¡/I¿¡BR¿ Intrinsic Motion C¡BR¿ Symmetric Energy¡BR¿ 2-Dimensional¡BR¿ Positive Entropy

¡TD align=center¿¡FONT SIZE=2¿ Space¡BR¿ Metric Symmetry¡BR¿ Conservation Domain¡BR¿ of Light¡BR¿

Interval = 0

¡TD align=center¿¡FONT SIZE=2¿ Matter-Antimatter¡BR¿ Leptoquark Pairs¡BR¿ Particle Symmetry¡BR¿ Color = 0¡BR¿ Number = 0

¡TD align=center¿¡FONT SIZE=2¿ Matter Surplus¡BR¿ Symmetry Breaking¡BR¿ W+, W-¡BR¿ Charges¡BR¿ Information ¡/TR¿

¡TR¿ ¡TD align=center¿¡FONT SIZE=2¿ Bound Energy¡BR¿ Asymmetric Forms¡BR¿ (raw energy¡BR¿ conservation)

¡TD align=center¿¡FONT SIZE=2¿ Mass: E=MC2¡BR¿ Intrinsic Motion T¡BR¿ Asymmetric Energy¡BR¿ 4-Dimensional¡BR¿

¡TD align=center¿¡FONT SIZE=2¿ Time¡BR¿ Metric Asymmetry¡BR¿ Conservation Domain¡BR¿ of Matter¡BR¿ Interval gt; 0

¡TD align=center¿¡FONT SIZE=2¿ Hadrons, Quarks¡BR¿ Sub-elementary¡BR¿ Particles¡BR¿ Color gt; 0¡BR¿ Asymptotic Freedom

¡TD align=center¿¡FONT SIZE=2¿ Leptons, Neutrinos¡BR¿ Elementary¡BR¿ Particles¡BR¿ Number gt; 0¡BR¿ Charge Carriers ¡/TR¿

¡TR¿ ¡TD align=center¿¡FONT SIZE=2¿ Particle Charges¡BR¿ Symmetry Debts¡BR¿ (symmetry¡BR¿ conservation)

¡TD align=center¿¡FONT SIZE=2¿ Electric Charge ¡BR¿ (dimensional ¡BR¿ asymmetry)¡BR¿ Charge = 0

¡TD align=center¿¡FONT SIZE=2¿ Gravitational Charge¡BR¿ (location asymmetry) ¡BR¿ Intrinsic Motion G¡BR¿ Negative Entropy

¡TD align=center¿¡FONT SIZE=2¿ Color Charge¡BR¿ (partial charge¡BR¿ asymmetry)¡BR¿ Quantum Confinement

¡td align=center¿¡FONT SIZE=2¿ Number Charge ¡BR¿ (identity asymmetry)¡BR¿ Particle Production ¡/TR¿

¡TR¿ ¡TD align=center¿¡FONT SIZE=2¿ Field Vectors¡BR¿ Symmetry Payments¡BR¿ (free energy recovery)

¡TD align=center¿¡FONT SIZE=2¿ Photons¡BR¿ Information Systems¡BR¿ Chemical Reactions¡BR¿ Annihilation

¡TD align=center¿¡FONT SIZE=2¿ Gravitons¡BR¿ Stellar Processes¡BR¿ Quantum Radiance

¡TD align=center¿¡FONT SIZE=2¿ Gluons¡BR¿ Fusion¡BR¿ Proton Decay

¡TD align=center¿¡FONT SIZE=2¿ IVB's¡BR¿ Fission¡BR¿ Particle Decay ¡/TR¿

¡TR align=center¿¡TD COLSPAN=6¿¡FONT SIZE=2¿ John A. Gowan 1999¡BR¿ http://www.people.cornell.edu/pag ¡/TR¿ ¡/table border¿ ¡/table¿ ¡h3¿¡A name="partable"¿Particle Table¡/A¿¡/h3¿

¡table border¿ ¡caption¿The Quark and Lepton Families¡B¿ The Particle Spectrum and Weak Force Intermediate Vector Bosons¡/B¿¡/a¿ ¡/caption¿ ¡tr¿ ¡th colspan=40¿Quarks¡/th¿ ¡td colspan =15 align=center¿ Designations:¡/td¿ ¡th colspan=40¿Leptons¡/th¿ ¡td colspan=21 align=center¿Designations:¡/td¿ ¡/tr¿ ¡tr¿ ¡td colspan=40 align=center¿.¡/td¿ ¡td colspan=15 align=center¿.¡/td¿ ¡td colspan=40 align=center¿ W-, W+, Z¡/td¿ ¡td colspan=21 align=center¿IVBs¡/td¿ ¡/tr¿ ¡tr¿ ¡td colspan=40 align=center¿Lq¡/td¿ ¡td colspan=15 align=center¿Leptoquark¡/td¿ ¡td colspan=40 align=center¿vLq¡/td¿ ¡td colspan=21 align=center¿Leptoquar Neutrino¡/td¿ ¡/tr¿ ¡tr¿ ¡td colspan=40 align=center¿t, b¡/td¿ ¡td colspan=15 align=center¿Top, Bottom¡/td¿ ¡td colspan=40 align=center¿t-, vt¡/td¿ ¡td colspan=21 align=center¿Tau, Tau Neutrino¡/td¿ ¡/tr¿ ¡tr¿ ¡td colspan=40 align=center¿c, s¡/td¿ ¡td colspan=15 align=center¿Charm, Strange¡/td¿ ¡td colspan=40 align=center¿u-, vu¡/td¿ ¡td colspan=21 align=center¿Muon, Muon Neutrino¡/td¿ ¡/tr¿ ¡tr¿ ¡td colspan=40 align=center¿ u, d¡/td¿ ¡td colspan=15 align=center¿Up, Down¡/td¿ ¡td colspan=40 align=center¿e-, ve¡/td¿ ¡td colspan=21 align=center¿Electron, Electron Neutrino¡/td¿ ¡/tr¿ ¡tr¿ ¡td colspan=40 align=center¿Composite Particles¡/td¿ ¡td colspan=15 align=center¿Baryons, Mesons¡/td¿ ¡td colspan=40 align=center¿Elementary Particles¡/td¿ ¡td colspan=21 align=center¿Electrons, Neutrinos¡/td¿ ¡/tr¿ ¡tr¿ ¡td colspan=40 align=center¿ Primary Charge Carriers¡/td¿ ¡td colspan=15 align=center¿Hadrons¡/td¿ ¡td colspan=40 align=center¿Alternative

Charge Carriers¡/td¿ ¡td colspan=21 align=center¿Leptons¡/td¿ ¡/tr¿ ¡tr¿ ¡th colspan=40 align=center¿Primary Field, Symmetric¡/th¿ ¡td colspan=15 align=center¿Color¡/td¿ ¡th colspan=40 align=center¿Secondary Field, Asymmetric¡/th¿ ¡td colspan=21 align=center¿Identity¡/td¿ ¡/tr¿ ¡/table border¿

¡P¿ The W+, W-, and Z are the "Intermediate Vector Bosons" (IVB's) of the weak force; they mediate the creation and destruction of unpaired leptons and neutrinos, and transformations of identity between these elementary particles. ¡P¿ The elementary leptonic series consists of the electron (e), muon (u), tau (t), leptoquark (Lq), and their corresponding neutrinos (v). The electron, muon and tau are identical except for their masses (tau is the heaviest) and their identity charges (carried in explicit form by their neutrinos). The (hypothetical) Leptoquark is the even heavier ancestor of the quarks and leptons; it is indicated at the head of the quark series, for although a lepton when compressed, when expanded it produces the quarks. ¡P¿ The quarks are named up, down (u, d), charm, strange (c, s), and top, bottom (t, b). The u, c, t series carries a fractional electric charge of +2/3; the d, s, b series carries a fractional electric charge of -1/3. Quarks also carry the strong force "color" charge, vectored by a field of 8 "gluons". Gluons are massless, travel at velocity C, and consist of a color-anticolor charge. Baryons consist of three quarks, mesons of a quark-antiquark pair. Hadrons are the class of particles containing quarks, that is, the baryons and mesons. Baryons as a class all carry one and the same identity charge, whose explicit form is the leptoquark neutrino. ¡P¿ The leptons and leptoquark are the only known massive elementary particles. The neutrinos are the massless, "bare" or explicit form of the identity charges of their corresponding masive leptons. The quarks occur only as triplets confined to baryons or as quark-antiquark pairs in mesons. Quarks are produced by the internal expansion of the leptoquark. ¡P¿ Ordinary matter consists of the electron and u, d quark energy level only. The quark complement of a proton is (uud)+; that of a neutron is (udd). A corresponding set of antiparticles also exists, but is not shown.¡P align=center¿ ¡B¿¡A name="list"¿List of technical terms:¡/A¿¡/B¿¡P¿

¡ul¿ ¡l1¿Particles = fermions and bosons¡BR¿

¡l1¿Fermions = hadrons and leptons¡BR¿

¡l1¿Leptons = massive leptons (electron, muon, tau) and massless neutrinos (ve, vu, vt)¡BR¿

¡l1¿Bosons = photon, graviton, gluon, IVBs (field vectors, force carriers)¡BR¿¡BR¿

¡l1¿Charges: electric, location, color, identity ("number") (symmetry debts)¡BR¿

¡l1¿Forces: electromagnetic, gravitational, strong, weak (symmetry payments)¡BR¿¡BR¿

¡l1¿Symmetry Principles: ¡BR¿ ¡ul¿¡l1¿1) Noether's theorem (particles)¡BR¿ ¡l1¿ 2) Interval = 0 (spacetime)¡BR¿ ¡/ul¿ ¡l1¿Conservation Principles:¡BR¿ ¡ul¿¡l1¿ 1) raw, or total energy conservation¡BR¿ ¡l1¿ 2) entropy conservation¡BR¿ ¡l1¿ 3) symmetry conservation (= charge conservation)¡BR¿¡BR¿

¡/ul¿ ¡l1¿Spacetime Gauges: ¡BR¿ ¡ul¿¡l1¿C: space (light); (metrical symmetry, positive entropy, intrinsic spatial motion, mass equivalent energy (MC2)¡BR¿

¡l1¿G: time (mass); metric asymmetry, negative entropy, intrinsic temporal motion, mass equivalent entropy (GM)¡BR¿ ¡/ul¿ ¡l1¿Interaction Hierarchy:¡BR¿ ¡ul¿ ¡l1¿Graviton: space-mass-time interaction. Creates Time.¡BR¿

¡l1¿Photon: electric-magnetic interaction. Creates Space.¡BR¿

¡l1¿Gluon: color-quark interaction. Stabilizes baryons.¡BR¿

¡l1¿W, IVBs: lepton-neutrino interaction. Creates leptons.¡BR¿

¡l1¿?Leptoquark: lepton-hadron interaction. Creates baryons.¡BR¿

¡l1¿?H (Higgs): fermion-boson interaction. Creates leptoquarks (mass scalar).¡BR¿ ¡/ul¿¡/ul¿ ¡P¿

¡h3¿¡A name="Examples of Decays"¿Examples of Weak Force Decays¡/A¿: Leptons¡/h3¿ (antiparticles in uppercase)

¡p align=center¿t-(U+ x u-)W- $_{vt+vU+u-<BR>}$

A tau decays (via a muon-antimuon particle pair complex formed by the W-) to a tau neutrino, a muon antineutrino, and a muon.¡/p¿ ¡p align=center¿ u-(E+ x e-)W- $_{vu+vE+e-<BR>}$

A muon decays (via an electron-positron particle pair complex formed by the W-) to a muon neutrino, a positron neutrino, and an electron.¡/p¿ ¡p align=center¿(e- + v e)Z $_{ve+e-<BR>}$

An electron and electron neutrino interact via a complex formed with the Z and swap identities.¡/P¿

¡h3¿Examples of Weak Force Decays: Baryons and Mesons¡/h3¿

¡p align=center¿(neutron)(E+ x e-)W- $_{(proton)++vE+e-<BR>}$